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## Field Evaluation of Some Recently Developed Selections for High Nodulation and Value of Nodulation Variants of Chickpea

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### Abstract

Naturally occurring plants with large differences in nodulation capacities (including nonnodulation) within chickpea cultivars have been reported. Two cultivars, ICC 4948 (= G 130) and ICC 5003 (= K 850), from which such nodulation variants were identified during the mid-1980s, were susceptible to fusarium wilt a widely occurring soilborne disease, caused by *Fusarium oxysporum* f. sp. *ciceri*. This made multilocational evaluation of the nodulation variants difficult in some important chickpea-growing areas. Studies reported here suggest that high-nodulating variants can be identified from advanced breeding chickpea lines that were reported as tolerant to fusarium wilt. The potential value of these and previously reported nodulation variants for quantification of N<sub>2</sub> fixation, additional residual effect owing to additional N<sub>2</sub> fixation by the high nodulating selections, improving soil health, and better understanding of the symbiotic process have been discussed. The potential to develop stress-tolerant symbiotic chickpea lines has been indicated through successful identification of high mineral-N tolerant symbiotic selections.

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using Genstat 5 version 3.2 allowed comparisons of the selections among themselves, with their parents, with other parents as a group, and with the control cultivar ICC 5003.

Three of the 17 advanced breeding lines (ICCV 91016, ICCV 91019, and ICCV 91026) had HN selections that were significantly ( $P < 0.05$ ) better than their parents (Table 1). Some selections in these three advanced breeding lines and in ICC 4958, a germplasm accession, were significantly ( $P < 0.05$ ) better than others within their respective groups. The superiority in nodule mass (in some cases, at N1 and in others, at N2) of these ranged from 64% in CP 92252 (parent ICCV 91016) to 293% in CP 92296 (parent ICCV 91019). All of these produced more total dry matter than their parents and/or the other selections in their groups. The increase in total dry matter of the selections (forming significantly superior nodule mass) over their parents ranged from 5% in CP 92252 at N1, to 65% in CP 92296 at N2. In most cases, however, the increase was not statistically significant ( $P < 0.05$ ).

At the high soil N level, nodule mass of all chickpea lines (control, parents, and selections alike) was substantially reduced (by 53% on overall mean basis and by 49% in the control cultivar). But some selections, such as CP 92297 (parent ICCV 89230), CP 91368 (parent ICCV 89230), CP 92012 (parent 91019), and CP 92095 (parent ICCV 89305), formed nodule mass similar to or higher than that of the control at N1, and at N2, had <40% reduction. Such other selections as CP 92298 (parent ICCV 89230) and CP 92296 (parent ICCV 91019) showed 43–60% reduction in nodule mass at N2 from that at N1, but still had higher nodule mass (by 35–41%) at N2 than that formed by the HN control at N2. All these selections produced 5–65% higher total dry matter than their parents, and 14–39% higher than the control cultivar at N2. This is important because the correlation between the total dry matter and nodulation, though nonsignificant, was negative in this experiment. The study strongly indicates that it is possible to select for HN (and high N<sub>2</sub>-fixing) plants from agronomically accepted varieties. Also, these selections can produce a total dry matter similar to, or higher than their parents. The possibility of selecting HN lines at high soil N is also indicated. Such lines should depend more on nodule-fixed N than their parents, particularly when the soil N concentrations are suppressive to nodulation/N<sub>2</sub> fixation. As a result, they should produce high yield and/or spare soil N for the subsequent nonlegume crop.

## Value of Nodulation Variants

### Nonnodulating Lines As Reference for N<sub>2</sub> Fixation Quantification Studies

Reliable measurement of N<sub>2</sub> fixed by a legume is important if this N is to be managed appropriately. Principal assumptions of <sup>15</sup>N-based methodology are that the reference plant lacks the ability to fix N<sub>2</sub> and that the <sup>15</sup>N/<sup>14</sup>N ratio of its tissues is the same

**Table 1.** Mean values on nodule mass and total dry matter of single plant progenies selected for large differences in nodulation capacities within advanced breeding lines of chickpea, ICRISAT Asia Center, post-rainy season 1995/96<sup>1</sup>.

Parent	No. of selections	Type of means <sup>2</sup>	Nodule mass (mg plant <sup>-1</sup> )			Total dry matter (t ha <sup>-1</sup> )			Nodulation improvement <sup>3</sup> (%)
			N1	N2	Mean	N1	N2	Mean	
ICCV 89230	2	a	117 ± 15.9	74 ± 15.9	96 ± 10.1	2.2 ± 0.15	2.4 ± 0.15	2.3 ± 0.10	4
		b	114 ± 12.3	55 ± 12.3	85 ± 7.1	2.6 ± 0.12	2.4 ± 0.12	2.5 ± 0.07	-
ICCV 89302	6	a	129 ± 15.9	78 ± 15.9	103 ± 10.1	2.0 ± 0.15	2.4 ± 0.15	2.2 ± 0.10	-
		b	128 ± 9.2	62 ± 9.2	95 ± 4.1	2.1 ± 0.08	2.4 ± 0.08	2.3 ± 0.04	-
ICCV 91016	5	a	76 ± 15.9	21 ± 15.9	49 ± 10.1	2.1 ± 0.15	2.4 ± 0.15	2.3 ± 0.10	64, N1
		b	79 ± 9.5	39 ± 9.5	59 ± 4.5	2.0 ± 0.09	2.4 ± 0.09	2.2 ± 0.05	129, N2
ICCV 91019	3	a	36 ± 15.9	21 ± 15.9	29 ± 10.1	1.5 ± 0.15	1.9 ± 0.15	1.7 ± 0.10	293, N1
		b	92 ± 10.8	52 ± 10.8	72 ± 5.8	2.0 ± 0.10	2.4 ± 0.10	2.2 ± 0.06	273, N2
ICCV 91026	5	a	72 ± 15.9	47 ± 15.9	60 ± 10.1	1.8 ± 0.15	2.4 ± 0.15	2.1 ± 0.10	88, N1
		b	85 ± 9.5	26 ± 9.5	56 ± 4.5	1.9 ± 0.09	2.4 ± 0.09	2.2 ± 0.05	-
ICC 4958	2	a	65 ± 15.9	21 ± 15.9	43 ± 10.1	2.3 ± 0.15	2.9 ± 0.15	2.6 ± 0.10	41, N1
		b	60 ± 12.3	33 ± 12.3	47 ± 7.1	2.0 ± 0.12	2.7 ± 0.12	2.4 ± 0.07	99, N2
ICC 5003 (Control)			91 ± 15.9	46 ± 15.9	69 ± 10.1	1.3 ± 0.15	2.2 ± 0.15	1.8 ± 0.10	

1. Data for selected parents where selections were significantly different ( $P < 0.05$ ) from parents or among themselves for nodule mass.

2. a = mean values for the parent, b = mean values for selections from the parent.

3. Percentage of increase in nodule mass of a selection at N1 or N2 over its parent.

4. - = no improvement.







